

Factors Impacting the Digital Forecast Process

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Introduction – IFPS has brought about many changes to the way the NWS produces and delivers its services. The following list represents a preliminary attempt by the IFPS Science Steering Team (ISST) to identify factors impacting the forecast process in the digital era. These factors have been grouped into four categories, ranging in scope from the individual field office to those impacting the entire agency, and addressing both the digital forecast database and the service it provides to partners and customers. Given the interdependent nature of the digital forecast process, some factors, such as the resolution of the digital database, have relevance across all categories. This document is not intended to address every nuance of such interdependence, thus some factors such as the resolution of the NDFD, will not be listed in every category. Rather, this list is intended to generate discussion that will lead to a more complete assessment of the factors impacting the digital forecast process, and how these assessments might result in possible modification to the design of that process.

Category One – Impacts on an Individual Forecast Desk

Forecast Quality: The dramatic shift in the forecast paradigm dictates the agency place adequate resources on forecast verification efforts. Forecasters must know what they are trying to forecast as well as the quality of their current forecasts. How should these requirements be met? Should forecast verification be designed to compare forecast grids to an analysis grid (i.e., gridded verification), through comparing grid points to observations, or both? Any gridded verification effort is highly dependent upon an accurate analysis of record. This analysis of record should also be made available to forecasters in near real-time to diagnose the current state of the atmosphere, and contribute to the development of other forecast and verification tools such as gridded climatology. Determining definitions of forecast quality is important to contributing to any needed changes to the forecast system design. For example, what constitutes an accurate or skillful forecast or depiction of sky cover, wind, PoP, and temperature all the way out to seven days?

The interface with GFE: Editing grids can require much time and attention from the forecaster working in the system's current design. As a consequence, a forecaster's situational awareness can possibly be degraded. The combination of degraded situational awareness and the time required in editing multiple grids in an internally consistent manner diminishes a forecaster's ability to use the GFE effectively in the "nowcast" period. This also reduces time needed to maintain and pursue excellence in other field program areas (i.e., severe weather). How can the system be modified to best ensure forecasters spend an adequate amount of time analyzing and forecasting the weather (that is, doing meteorology), and not just performing unnecessary grid edits to produce depictions of these analyses and forecasts?

Collaboration Between WFOs: As the system is currently designed, careful collaboration is needed between neighboring WFOs in order to provide a nearly seamless National Digital Forecast Database while not sacrificing forecast accuracy. What is the best way for neighboring WFOs to agree on the forecasts without impacting time needed to accurately assess the meteorological situation and produce the digital forecast? Even if and when such agreement is

achieved, the wide variety of tools and methodologies employed by various WFOs can possibly introduce discontinuities between forecast grids. Should a set of standardized tools and techniques be established and used consistently by all WFOs? How much discrepancy is realized between WFOs by the use or availability of different forecast models that populate forecast grids, including possible use of locally run numerical models? Should there be a limit as to the number of forecast guidance resources used to create the grids? Finally, what is the best way to measure WFO collaboration skill? Are established consistency threshold values realistically attainable, and are such that the NWS provides acceptable digital services to NDFD partners and customers?

Category Two – Distribution of Duties in Producing the Digital Forecast Database

Roles of NCEP Service Centers and WFOs: What is the optimal mix of contributions by NCEP centers and the WFOs that can provide partners and customers with the highest quality digital service? Forecast knowledge and experience within NCEP service centers – especially in diagnosing and predicting the synoptic scale, and more importantly in extended forecast periods – should be employed, but in what fashion? What is the most effective way to include this skill into the digital forecast process given current forecaster resources at WFOs and national centers?

Roles of Humans and NWP: Forecasters are currently being asked to insert mesoscale detail into degraded numerical model output by locally developing and applying oftentimes simple grid-editing tools. While it is well known that forecasters can improve upon model guidance (and MOS) for selected cities, it is still unproven whether the use of these grid-editing tools can improve upon numerical model output beyond these few locations and throughout all seven days. Currently, this is even a greater challenge given that model guidance available to the forecasters in GFE is typically degraded from the full-resolution model grids that are logical benchmarks used to assess skill. Even full resolution grids contain model biases and deficiencies that must be addressed. This initial step is generally best done objectively through statistical post-processing rather than with manual editing. It is also important to consider the role of the forecaster in providing forecast-to-forecast “stability”. Model solutions – especially in the extended terms – often vary significantly from run-to-run. While they may tend to converge on the correct solution, forecasters can dampen these oscillations to produce a forecast that over time trends toward a more accurate solution. Where should the forecaster be within the forecast process? Which digital process steps are best accomplished by the forecaster and by NWP models?

Category Three – Characteristics of the Digital Forecast Database

The Limits of Predictability: The science of meteorology has been shown to provide only limited skill in forecasting the behavior of synoptic-scale features seven days in advance. Despite this limitation, forecasters are producing grids at high spatial and temporal resolutions out to seven days. There is some ability to predict local processes that are strongly forced by terrain and diurnal heating that far in advance if the synoptic pattern is known, such as an afternoon sea breeze or mountain-valley flows. Yet sensible weather which owes its development to transient baroclinically-forced features is much less predictable. Can the digital forecast database accurately depict the detail that the state of the science justifies without implying a precision that the chaotic nature of baroclinic instability precludes?

Spatial and Temporal Resolution: Given the limits of predictability inherent in current system resolution, what is the optimal spatial and temporal resolution needed that provides a useful digital service while retaining scientific validity? Should the spatial resolution of the digital

database be finer in the near term and coarser in the mid range as deterministic skill will most often diminish, or should the spatial resolution of the digital database remain fixed in time? To address this issue, “nested” spatial resolutions of the digital database could be considered. For example, there could be an upscaled national depiction, a moderately-scaled regional depiction, and a detailed local depiction. However, how can a National, routinely-scheduled, NDFD most effectively mesh with a local, event-driven grid? Likewise, should there be limits on temporal resolutions allowed as the forecast time period increases. Or, should it remain flexible so forecasters may still depict changes at high temporal resolutions during extended forecast periods in times of greater forecast predictability (e.g., terrain or thermally forced flows)?

The Probabilistic Component: Should the digital forecast database include a probabilistic component that conveys to partners and customers measures of forecast uncertainty? If so, what is the best way to produce and deliver this component, and in what forecast time period? Should it be produced and provided for all forecast periods, or just extended forecast periods when predictability is typically lower. Should this be a grid or set of grids that forecasters could possibly edit? Under some regimes the spectrum of possibilities is bimodal, including when, for example, whether or not a surface-based temperature inversion will break or during mountain-valley circulations. At other times the spectrum of possibilities is less bounded. How can the probabilistic component of these varied regimes all be expressed appropriately?

Area vs “Point” Forecasts: A forecast for an individual grid box is not equivalent to a forecast for a specific point within that box. Any one grid box may contain several observations that could be used as verification, both internally and by external system users performing their own verification. How can this difference best be communicated to our forecasters and customers? How can the digital forecast database best depict detail at the “neighborhood” scale without implying accuracy at the “back yard” scale? If point forecasts are in fact what we want to provide, how can this best be done given the digital database is made up of grid boxes and not points?

Category Four – Needs of the Customer

Access to the Digital Database: What presentation of the digital database will maximize its accessibility and utility to partners and customers, both locally and nationally? Where and how will they access this database or databases? Ideally, a single database could be queried by a variety of users, with results being tailored to meet each of their unique needs. If multiple grids are delivered (e.g., a coarser NDFD and a finer-resolution local grid), a delivery system is needed that makes straightforward use of each grid and eliminates any potential confusion, thus making grid access locations nearly transparent.

Collaboration Between the NWS and its Partners and Customers: The advent of digital forecasting brings a dramatic change to the way partners and customers access and use NWS forecasts. How can the NWS best publicize the digital database and introduce it to its users so they can take full advantage of its potential? Many of these users have become increasingly sophisticated in their (proposed) use of digital information just over the past year. How can the NWS learn from these customers and thereby possibly improve the digital database in order to ensure its utility?

Forecast Update Frequency: Would the needs of partners and customers be adequately served if updates to the digital database were made at routine times, or as events warrant? A combination of the two would be possible if there were separate local and National grids. What update frequency can be realistically considered given system and forecaster workload limitations?